



IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of)

Genji IMAI et al.)

Serial No.: 09/418,368)

Group Art Unit: 1752

Filed: October 14, 1999)

Examiner: Hamilton C.

FOR: A Positive Sensitive Resin Composition)
and a Process For Forming a Resist Pattern)
Therewith)

DECLARATION UNDER 37 C.F.R. §1.132

Assistant Commissioner of Patents
Washington, D.C. 20231

Sir:

I, Genji IMAI, do hereby solemnly and sincerely declare as follows:

1. I am one of the joint inventors in the above application..
2. I have reviewed the above-identified application, the Official Action of April 5, 2001 and the prior art cited by the Examiner.
3. The following experiment was carried out by me or under my direct supervision and control:

Experiments:

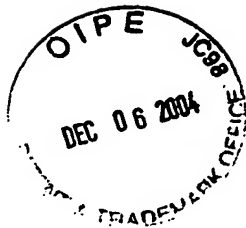
The following experiments were carried out to demonstrate the advantage of the present invention against Imai et al., US 5,496,678.

Experiment 1:

Copolymerization described in Example 3 of the present invention was repeated. Composition ratio of copolymer, the results of analyses for a product copolymer and evaluation for resist-film performance are shown in the following table.

Experiment 2:

Copolymerization described in Synthesis Example 2 of US 5,496,678 was repeated. Composition ratio of copolymer, the results of analyses for a product copolymer and evaluation for resist-film performance are shown in the following table.



	Copolymer (composition ratio)			Polymerization results					
	Styrene monomer	Acrylate	Acrylic acid	Mw	Mw/Mn	Solvent solubility (wt%)	Line/space ($\mu\text{m}/\mu\text{m}$)	Transparency (%/μm)	Thermal stability (°C)
	a	b	c						
Ex. 1	PIPE ¹⁾ 0.43	MA ²⁾ 0.38	0.19	9,800	1.85	>50	50/100	>98	>200
Ex. 2	HS ³⁾ 0.48	BA ⁴⁾ 0.36	0.16	5,200	1.67	>50	30/30	85	180

Note: 1) 4-(1-methylethenyl)phenol

2) Methyl acrylate

3) p-hydroxystyrene

4) n-butyl acrylate



As shown in the above table, the copolymer of Imai is inferior in transparency and thermal stability to that of the present invention. The performance of the resist-film using the copolymer of Imai is also worse than that of the present invention.

4. All statements made herein of my own knowledge are true and all statements made on information and belief are believed to be true. Further, I am aware that willful false statements and the like are punishable by fine, imprisonment or both under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of this application or any patent issuing thereon.

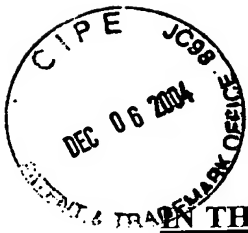
5. Further deponent saith not.



Signature



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Sir:

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1. I am one of the joint inventors in the above application..
2. I have reviewed the above-identified application, the Official Action of April 3, 2002 and the prior art cited by the Examiner.
3. The following experiment was carried out by me or under my direct supervision and control:

Experiments:

The following experiments were carried out to demonstrate the advantage of the present invention against Imai et al., US 5,496,678, again.

Experiment 1:

Copolymerization described in Example 1 of the present invention was repeated. Composition ratio of copolymer, the results of analyses for a product copolymer and evaluation for resist-film performance are shown in the following table.

Experiment 2:

Copolymerization described in Example 1 of the present invention was repeated except that 120 g of p-hydroxystyrene (1.00 mol) was used instead of 4-(1-methylethenyl)phenol. Composition ratio of copolymer, the results of analyses for a product copolymer and evaluation for resist-film performance are shown in the following table.

Experiment 3:

Copolymerization described in Example 1 of the present invention was repeated except that 120 g of p-hydroxystyrene (1.00 mol) and 213 g of butyl acrylate (1.67 mol) were used instead of 4-(1-methylethenyl)phenol and methyl acrylate, respectively. Composition ratio of copolymer, the results of analyses for a product copolymer and evaluation for resist-film performance are shown in the following table.

			Polymerization results					
	Styrene monomer a	Acrylate b	Mw	Mw/Mn	Solvent solubility (wt%)	Line/space ($\mu\text{m}/\mu\text{m}$)	Transparency (%/μm)	Thermal stability (°C)
Ex. 1	PIPE ¹⁾	MA ²⁾	10,000	1.94	>50	50/100	>98	>200
Ex. 2	HS ³⁾	MA ²⁾	9,800	1.95	>50	30/30	85	190
Ex. 3	HS ³⁾	BA ⁴⁾	9,500	1.94	>50	30/30	90	180

Note: 1) 4-(1-methylethenyl)phenol

2) Methyl acrylate


3) p-hydroxystyrene

4) n-butyl acrylate

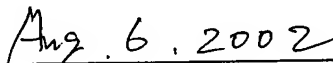
In general, the acrylate component in such a 3-component type resist contributes to improvement of hydrophobicity. That is, the ester chain is longer, hydrophobicity is more improved. Further, as can be seen from the comparison of Ex. 2 and Ex. 3, copolymer using MA is inferior in transparency to that using BA as an acrylate component. The performance of the resist-film using the copolymer of Imai is also worse than that of the present invention. In particular, from the above-mentioned result, it can be understood that a contribution of PIPE to the transparency is very large.

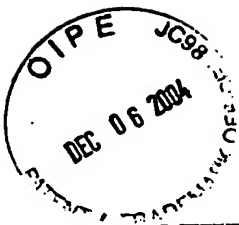
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Sir:

I, Genji IMAI, do hereby solemnly and sincerely declare as follows:

1. I am one of the joint inventors in the above application.
2. I have reviewed the above-identified application, the Official Action of April 3, 2002 and the prior art cited by the Examiner. I have further considered the Advisory Action of August 14, 2002.
3. The following experiment was carried out by me or under my direct supervision and control:

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filed 12-3-02

A/S
C/S

Experiments:

The following experiments were carried out to demonstrate the advantage of the present invention against Imai et al., US 5,496,678, again.

Experiment 1:

Copolymerization described in Example 1 of the present invention was repeated. The results of analyses for a product copolymer and evaluation for resist-film performance are shown in the following table.

Experiment 2:

Copolymerization described in Example 1 of the present invention was repeated except that 120 g of p-hydroxystyrene (1.00 mol) was used instead of 4-(1-methylethenyl)phenol. The results of analyses for a product copolymer and evaluation for resist-film performance are shown in the following table.

Experiment 3:

Copolymerization described in Example 1 of the present invention was repeated except that 120 g of p-hydroxystyrene (1.00 mol) and 213 g of butyl acrylate (1.67 mol) were used instead of 4-(1-methylethenyl)phenol and methyl acrylate, respectively. The results of analyses for a product copolymer and evaluation for resist-film performance are shown in the following table.

Experiment 4:

Copolymerization described in Example 1 of the present invention was repeated except that 213 g of butyl acrylate (1.67 mol) were used instead of methyl acrylate. The results of analyses for a product copolymer and evaluation for resist-film performance are shown in the following table.

		Polymerization results						
	Styrene monomer a	Acrylate b	Mw	Mw/Mn	Solvent solubility (wt%)	Line/space ($\mu\text{m}/\mu\text{m}$)	Transparency ($\%/\mu\text{m}$)	Thermal stability ($^{\circ}\text{C}$)
Ex. 1	PIPE ¹⁾	MA ²⁾	10,000	1.94	>50	50/100	>98	>200
Ex. 2	HS ³⁾	MA ²⁾	9,800	1.95	>50	30/30	85	190
Ex. 3	HS ³⁾	BA ⁴⁾	9,500	1.94	>50	30/30	90	180
Ex. 4	PIPE ¹⁾	BA ⁴⁾	9,800	1.94	>50	50/100	>97	>190

Note: 1) 4-(1-methylethenyl)phenol

2) Methyl acrylate

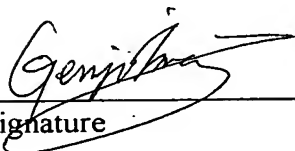
3) p-hydroxystyrene

4) n-butyl acrylate

As can be seen from the above results, the copolymers of Ex. 1 and Ex. 4 according to the present invention are excellent in resolution, transparency and thermal stability compared with those of Ex. 2 and 3 according to Imai et al. In particular, the comparison of Ex. 3 and 4 clearly demonstrates the effect of using PIPE. Therefore, the present invention exhibits superior effects which is not obvious over Imai et al.

4. All statements made herein of my own knowledge are true and all statements made on information and belief are believed to be true. Further, I am aware that willful false statements and the like are punishable by fine, imprisonment or both under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of this application or any patent issuing thereon.

5. Further deponent saith not.



Signature

November 15, 2002
Date